

1.0 INTRODUCTION

ERM-West, Inc. (ERM) has prepared this *2005 Annual Progress Report* for the Old Hammer Field (OHF) site in Fresno, California. This report has been prepared on behalf of the Old Hammer Field Steering Committee (OHFSC), which includes the City of Fresno, United States Army Corp of Engineers, the United States National Guard Bureau, and the Boeing Company.

1.1 BACKGROUND INFORMATION

This section provides a general background description of the site, a history of site usage, and a description of investigations previously completed at the site.

1.1.1 Site Description

OHF encompasses approximately 1,598 acres northeast of downtown Fresno, California (Figure 1-1). The OHF boundaries are based on the historical perimeter of the former Hammer Field Army Air Base, which corresponds closely to the perimeter of the Fresno-Yosemite International Airport.

Numerous military and civilian entities have performed industrial activities at OHF since it was developed in the 1940s. Based on the types and locations of historical activities, OHF has been divided into several distinct environmental investigation areas. Area 1, which is also referred to as the Redevelopment Area (Figure 1-2), has been the primary focus of investigations and remedial activities at OHF. Area 1 has historically had the most intensive industrial activity at OHF, both during and after World War II. The most notable activities in this area with respect to environmental concerns have been related to aircraft maintenance and fueling operations.

1.1.2 Site History

This section briefly summarizes the history of OHF and describes historical features and industrial operations in Area 1. For a detailed history of the OHF site, refer to the *Remedial Action Plan for Area 1 Soil and Ground Water* (ERM, 2004).

1.1.2.1 *Hammer Field Army Air Base*

Prior to 1941, the area was used for agricultural purposes. In August 1940, a War Department Board of Officers selected Fresno as the site of a World War II Army Air Base. Development of the Hammer Field Army Air Base began in April 1941 on land leased from the City of Fresno. Activities conducted at the base included those generally associated with the operation of a major airfield, including aircraft maintenance and fueling. In December 1946, the City of Fresno assumed operation of the airfield and developed the property as a municipal airport. Between 1946 and the present, the City has leased many of the buildings at the airport to various civilian and military tenants.

1.1.2.2 *Area 1 History*

Area 1 is historically the most industrially active portion of both the original military facility and subsequent civilian airport. Area 1 encompasses the 78-acre Redevelopment Area along the eastern side of OHF (Figure 1-2), as well as the downgradient extent of a chlorinated volatile organic compound (VOC) plume that originates in this area. Current and historical features in the Redevelopment Area were described in the *Final Area 1 Remedial Investigation Report* (Area 1 RI) (ERM, 2000a) and the *Decision Document for 96 Potential Waste Sites* (Decision Document) (ERM, 1996a). The primary activities conducted in Area 1 have included aircraft fueling and maintenance, automotive parts and engine handling, and manufacturing.

1.1.3 *Previous Investigations*

This section briefly summarizes the previous investigations conducted at OHF. For details regarding these investigations, refer to the *Remedial Action Plan for Area 1 Soil and Ground Water* (ERM, 2004).

Between 1991 and 1996, several evaluations of OHF were performed to delineate environmental investigation areas based on the history of the site, as well as to prioritize these areas for future investigation. In addition, separate evaluations have been completed to address VOCs related to the California Air National Guard (CANG) Base.

Previous investigations concluded that the primary environmental concern was associated with Area 1 and consisted of chlorinated VOCs in soil and ground water. A chlorinated VOC plume was discovered in ground water that originates within the Hangar P3/Building T282 Area in

Area 1 and presently extends southwest beyond the original boundaries of the OHF (Figure 1-2).

Trichloroethylene (TCE) is the dominant compound in terms of concentrations and areal extent. The plume is more than 2-miles long and extends from the water table at approximately 100 feet below ground surface (bgs) to depths below 300 feet bgs. The impacted aquifer is pumped intensively in the region for domestic, municipal, agricultural, and industrial water supplies.

In addition, the CANG Base, which is located within the boundaries of OHF, was also identified as the source of VOCs to ground water. A tetrachloroethene (PCE) ground water plume has been identified emanating from the CANG Base. The PCE plume extends approximately 1,500 feet southwest of McKinley Avenue, and is fully encompassed by the Area 1 VOC plume. Therefore, the CANG PCE plume and the OHF VOC plume were integrated in subsequent assessments and remedial efforts.

A Human Health Risk Assessment (HRA) was performed for the Area 1 soil, soil vapor, and ground water. The assessment was summarized within the *Area 1 Health Risk Assessment Addendum* (ERM, 2002), which was completed in February 2002. The HRA was based on the data collected during the RI (ERM, 2000a) and drew the following conclusions:

- Chemical constituents identified in soil and soil vapor under either a residential or industrial risk scenario do not pose unacceptable health risks; and
- VOCs identified in both on- and off-site ground water exceeded the State Department of Toxic Substances' (DTSCs) benchmarks for evaluation of acceptable risk.

Based on the results of the RI and the HRA, remedial action objectives (RAOs) were developed to address health risks and ensure ground water resources are protected. In order to meet the RAOs and to ensure that VOC concentrations in soil vapor and ground water do not exceed the remedial goals, a Feasibility Study was conducted to evaluate potential remediation alternatives. The results of the Feasibility Study were used to develop the *Remedial Action Plan for Area 1 Soil and Ground Water* (ERM, 2004), which was completed in May 2004. The remedial action plan selected Alternative 4 as the preferred remedial approach for Area 1. Alternative 4 included Institutional/Engineering Controls, Long-term Monitoring, Source Area Treatment, and Toe-of-Plume Ground Water Extraction. Design and implementation details of this remedial approach

2.0

GROUND WATER MONITORING

Quarterly ground water sampling was conducted at OHF to monitor ground water conditions at the site, specifically the extent of the chlorinated VOC plume that originates in Area 1. The scope of the ground water monitoring program is described in detail in the RDIP. Well sampling frequency and analytical requirements are listed in the RDIP. No sampling occurred during the First Quarter of 2005 due to budget constraints. Data collected during the Second, Third, and Fourth Quarter sampling events are summarized below, with emphasis on the most recent (Fourth Quarter 2005) ground water monitoring event. Results for the Second and Third Quarterly sampling events were provided to the DTSC and Regional Water Quality Control Board (RWQCB) on 10 October 2005 and 13 December 2005. An addendum to the Third Quarter report was submitted on 15 December 2005.

2.1

SAMPLING PROGRAM

Ground water elevation measurements were collected in December 2005 from 55 monitoring wells associated with the OHF site and 8 wells located on the CANG facility. Ground water level measurements collected during 2005 are presented on Table 2-1.

Ground water samples were collected using the methods described in the Standard Operating Procedures for Ground Water Sampling, included as Appendix F in the Sampling and Analysis Plan (ERM, 1996b). A list of wells from which samples were collected during the Fourth Quarter event is provided on Table 2-2. Ground water samples were collected from 55 OHF wells, 8 CANG wells, 9 public water supply wells, 3 City of Fresno monitoring wells, and 2 domestic wells. Six new wells were added to the sampling program during the Fourth Quarter.

Prior to 2005, OHF ground water samples were analyzed for VOCs using United States Environmental Protection Agency (USEPA) Method 8021. Beginning in 2005, OHF ground water samples were analyzed for VOCs by USEPA Method 8260B. Public water supply wells and domestic well samples were collected in accordance with the Water Supply Contingency Plan (ERM, 2000b) and analyzed for VOCs by USEPA Drinking Water Method 524.2. A list of analytes for each test method is included on Table 2-3.

Ground water samples were collected using passive diffusion bag (PDB) samplers at all well locations, except newly installed wells HFMW-53C, -D, -E, -F and the domestic and public water supply wells. Wells HFMW-53C, -D, -E, -F were sampled 2 weeks after development by traditional purge and sampling techniques. At the request of the RWQCB, samples from newly installed B-Zone wells (HFMW-35B through HFMW-46B) were collected using PDBs placed at approximately 107, 115, and 124 feet bgs during the Third and Fourth Quarters. Results were then used to determine which depth exhibited the highest VOC concentrations, and samples would be collected from that depth during subsequent sampling events. However, multiple depths were sampled a second time from HFMW-38B and HFMW-42B during the Fourth Quarter at the request of the RWQCB. Also, well HFMW-36B was sampled using purge methods during the Third Quarter and was not sampled at 107 feet bgs during the Fourth Quarter due to insufficient water in the PDB.

2.2 HYDROGEOLOGIC CONDITIONS

During the Fourth Quarter 2005 sampling event, 31 A-Zone monitoring wells at OHF were dry due to continued regionally declining ground water levels. Due to the number of dry wells, sufficient data was not available to verify the ground water flow direction in the A/B-Zone during the Second Quarter. As part of the RDIP, 12 new B-Zone monitoring wells were installed throughout Area 1. Potentiometric surface maps for the B-Zone for the September and December 2005 quarterly sampling events are shown as Figures 2-1 and 2-2.

Potentiometric surface maps for the C-Zone for the 2005 quarterly sampling events are included as Figures 2-3 through 2-5. As shown on these figures, water levels throughout the site continue to be strongly influenced by the operation of Well 70. Water level hydrographs for selected wells are provided on Figure 2-6. In addition to the generally decreasing water level trends shown on this figure, consistent downward gradients are also observed where multi-zone well clusters are present. A summary of the vertical gradients between the B- and C-Zone wells and the C- and E-Zone wells is provided on Table 2-4.

2.3 WELL 70 INTERIM ACTION EFFECTIVENESS

Influent TCE and PCE concentrations and flow data for the Well 70 treatment system during 2005 were provided by the City of Fresno Water Division and are included on Table 2-5. Figure 2-7 provides a comparison

of the TCE concentration in Well 70 to the volume of ground water pumped monthly by Well 70. TCE concentrations in Well 70 during 2005 averaged 19.3 micrograms per liter ($\mu\text{g/L}$), which is less than the average TCE concentration during 2004 (22.3 $\mu\text{g/L}$). PCE was detected at concentrations of 0.28 $\mu\text{g/L}$ in July and September 2005 and 0.35 $\mu\text{g/L}$ in December 2005, but was not detected during the remainder of the year. The cumulative mass of TCE and PCE removed from the ground water by Well 70 is shown on Figure 2-8. Since pumping at Well 70 resumed in January 1999, approximately 5.1 billion gallons of water have been extracted and treated. Approximately 888 pounds of TCE and 13 pounds of PCE have been removed from this volume of water and processed by the aboveground treatment system.

In correspondence dated 27 June 2005, the RWQCB requested that a summary of hours of operation and pumping rates for City Wells 70 and 32B be provided with quarterly ground water monitoring reports. This information was provided by the City of Fresno Water Division for the period of January through December 2005 and is summarized on Table 2-6.

2.4

CHEMICAL DISTRIBUTION

Concentrations of select VOCs detected in ground water samples are summarized on Table 2-7. This table also presents ground water data collected during the previous monitoring events for comparison to Fourth Quarter 2005 sampling event results. A summary of ground water VOC analytical results to date is presented on Table A-1 (Appendix A). The complete laboratory analytical reports from the Fourth Quarter 2005 sampling event are also included in Appendix A.

An analysis of quality assurance/quality control data (QA/QC) was performed for the Fourth Quarter 2005 sampling event. During QA/QC review, it was noted that the laboratory missed the hold times on the following samples: HFMW-19C, HFMW-36B-124, HFMW-47D, -47E, -47F, and HFMW-49C, -49D, -49E. Therefore, ERM re-sampled the above listed wells on 18 January 2006. Field sampling and laboratory data were reviewed with respect to the *Revised Quality Assurance Project Plan* (ERM, 1997). All analytical results were found to be acceptable. A summary of this data review is provided in Appendix A of this report, along with the laboratory analytical reports.

The distribution of TCE in ground water is shown on Figures 2-9 (Zones A and B) and 2-10 (Zones C, D, E, and F). Additional monitoring wells

installed in 2005 provide additional definition of the TCE plume shape. As a result, the plume shape and overall extent have changed compared to previous depictions. The 100 µg/L contour is not as extensive as previously depicted. In addition, the Southeast Plume and the P-3 Plume appear to have merged into one plume. HydroPunch® data had been used previously to show a separation of the plumes, but only one plume appears to be present based on the current network of wells.

As shown on Table 2-7, TCE concentrations in many wells upgradient, cross-gradient, and downgradient from Well 70 have decreased over time. One exception to this trend is downgradient well HFMW-19C, in which TCE concentrations appear to have increased slightly; however, the concentrations are within the range of historical maximum and minimum values.

Figure 2-11 presents detections of PCE during the Fourth Quarter 2005 sampling event. Concentrations of PCE within the CANG Base continue to decrease as a result of the operation of Well 70.

During 2005, TCE, PCE, and 1,1-Dichloroethane were not detected above the warning level (2.5 µg/L) in the water supply wells monitored as part of the Water Supply Contingency Plan.

were then developed and presented in the *Remedial Design and Implementation Plan for Source Area Soil and Ground Water (RDIP)* (ERM, 2005a) described in Section 3.0 of this report.

1.2 SUMMARY OF 2005 SITE ACTIVITIES

The objective of this report is to provide a comprehensive summary of site activities completed in 2005. The following activities were completed in 2005 and are described further in subsequent sections of this report:

- Quarterly ground water monitoring;
- Design of the proposed remedial actions;
- Finalizing the Water Supply Contingency Plan;
- Installation of additional monitoring wells to upgrade the site-wide monitoring well network;
- Construction and startup of the soil vapor extraction (SVE) system at the P-3 Area; and
- Implementation of the initial potassium permanganate (KMnO₄) injection event for the in situ chemical oxidation (ISCO) program.

An additional off-site ground water investigation was also initiated in 2005. The investigation included the installation of new multi-depth monitoring wells as well as performing a capture analysis for Well 70. The details of this investigation will be submitted as a separate report in March 2006.

1.3 DOCUMENT ORGANIZATION

This document is organized into eight sections. Following this introductory section, the report addresses:

- Results from ground water monitoring, focusing on Fourth Quarter 2005 (Section 2.0);
- Development and implementation of remedial action designs (Section 3.0);
- Installation of on-site and off-site monitoring wells (Section 4.0);
- Design, construction, and implementation of the SVE program (Section 5.0);

- Design and implementation of the ISCO program (Section 6.0);
- Planned activities for 2006 (Section 7.0); and
- References used in this report (Section 8.0).

Figures and tables immediately follow the text.

The RDIP (ERM, 2005a) was prepared and submitted to the DTSC and RWQCB on 7 March 2005. The RDIP provided detailed approaches to the remediation of impacted soil, soil vapor, and ground water in the source areas of Area 1 and the Southeast Plume at OHF. The DTSC and RWQCB provided RDIP comments on 6 May 2005. ERM revised the RDIP in accordance with the comments and submitted a revision to the RDIP on 21 June 2005. The DTSC provided approval of the final RDIP on 7 July 2005. Soon thereafter, implementation of the remediation actions presented in the RDIP began and are currently ongoing. Sections 4.0, 5.0, and 6.0 of this report provide summaries of the work completed in 2005.

An investigation at the Southeast Plume was completed in 2005 and a report summarizing the activities and findings was submitted to the DTSC on 8 February 2006 (ERM, 2006a). Activities conducted in 2005 for the Southeast Plume include ground water monitoring of several wells and replacement of two monitoring wells in the area. Based on the investigation, the OHFSC and ERM recommended no active remedial actions for the Southeast Plume. Instead, it was recommended that the existing wells in this area be incorporated into the site-wide quarterly monitoring program.

ERM, on behalf of the OHFSC, submitted a *Draft Remedial Design and Implementation Plan for Down Gradient Ground Water* to the State on 6 May 2005 (ERM, 2005b). The plan proposed an off-site ground water extraction system to capture and treat impacted ground water downgradient of the source area and the CANG Base. However, based on further evaluation of the historical and recent ground water analytical data, a change in remedial strategy for the Toe-of-Plume ground water was proposed in letters to the DTSC dated 16 September 2005 (ERM, 2005c) and 25 September 2005 (ERM, 2005d). The DTSC provided approval of the proposed strategy, which included additional investigation and monitoring, in a letter dated 17 October 2005 (DTSC, 2005). The additional investigation and monitoring activities were initiated in late 2005 and included the installation and monitoring of 11 new wells at four locations, as well as on-going quarterly ground water sampling of existing wells. Findings of the investigation will be summarized and submitted to the DTSC in March 2006, along with results from an updated Well 70 capture zone analysis.

4.0

MONITORING WELL INSTALLATION PROGRAM

During 2005, new ground water monitoring wells were installed both on-site and off-site as follows:

- Thirteen new monitoring wells were installed on-site to monitor the effectiveness of the ISCO program, replace dry A-Zone wells, and supplement the existing well network;
- Seventeen new monitoring wells were installed off-site to monitor the downgradient edge of the Area 1 VOC plume and assess the vertical distribution of VOCs; and
- One new piezometer and three of the above mentioned wells were installed off-site to better evaluate the Well 70 capture zone.

New wells were installed in accordance with the scope of work described in the RDIP (ERM, 2005a) and the *Proposed Changes to the Toe-of-Plume Ground Water Remedial Action – Old Hammer Field, Fresno, California* (ERM, 2005c,d). Additional details on installation of new monitoring wells are provided in the subsections that follow.

4.1

ON-SITE MONITORING WELLS

Nine new monitoring wells were installed on-site to monitor the performance of the ISCO program in the Area 1 source area; these include six wells to monitor the effectiveness of ISCO in the source area (HFMW-35B through HFMW-38B, HFMW-41B and HFMW-42B) and three wells to assess potential downgradient migration of KMnO_4 (HFMW-39B, HFMW-40B, HFMW-40C). Three new monitoring wells were installed south of the Area 1 source to further delineate the Southeast Plume (HFMW-44B through HFMW-46B). One new monitoring well was installed west of the source to monitor the northwestern, cross-gradient edge of the VOC plume (HFMW-43B). The locations of new on-site monitoring wells are shown of Figure 4-1.

All new on-site monitoring wells were installed using a hollow-stem auger drill rig and were constructed using 2-inch diameter, Schedule 40, polyvinyl chloride (PVC) casing and screened with 0.02-inch perforations. B-Zone wells were screened at approximately 100 to 125 feet bgs. HFMW-40C (C-Zone) was screened at 136 to 146 feet bgs. Table 4-1 summarizes construction details for all new on-site monitoring wells.

OFF-SITE MONITORING WELLS

Eight new sentry wells were installed off-site to monitor the downgradient edge of the Area 1 VOC plume; these include two triple-completion, nested well sets with wells screened in the C-, D-, and E-zones (HFMW-49C, -49D, -49E; HFMW-50C, -50D, -50E) and two single completion wells screened in the C-Zone (HFMW-48C and HFMW-51C). Three new wells were installed off-site near Well 70 to monitor potential vertical migration of TCE due to pumping from Well 70 (HFMW-47D, -47E, -47F). Six new wells and one new piezometer were installed off-site to further delineate the lateral and vertical extent of TCE at the toe-of-the-plume and confirm the capture zone of Well 70; these include two monitoring well sets consisting of clustered, single completion wells (HFMW-52D, -52E; HFMW-53C, -53D, -53E, -53F) and piezometer HFPZ-04. The locations of new off-site monitoring wells are shown on Figure 4-2.

All new off-site wells were installed using a mud rotary drill rig and were constructed of 2-inch diameter, Schedule 40, PVC casing and screened with 0.020-inch perforations. New off-site wells were constructed with 10-foot screen intervals. Table 4-1 summarizes construction details for all new off-site monitoring wells.

5.0

SOIL VAPOR EXTRACTION (SVE) PROGRAM

As described in the RDIP (ERM, 2005a), a SVE system was designed and implemented in the Area 1 source area (also referred to as the Hangar P3 area) to address VOC concentrations in soil and soil vapor.

5.1

SVE SYSTEM INSTALLATION

A permit application for the construction of the SVE system was submitted to the San Joaquin Valley Air Pollution Control District (APCD) and approved on 12 October 2005 (ACPD, 2005). Installation of the system was performed between 17 October 2005 and 2 December 2005 in accordance with RDIP.

SVE wells and monitoring points were installed between 4 August and 26 August 2005, with the exception of SVE wells VEA-03 and VEB-03 and monitoring points VMP-01 and VMP-02. These wells were installed in June 2004 for the SVE pilot test, which is summarized in the RDIP. Construction details of the SVE wells and monitoring points are provided in Table 5-1. The process piping was installed between 17 October and 10 November 2005. A total of ten SVE wells were divided into three treatment zones (described in Section 5.2) and connected by zone using Schedule 80 PVC process piping. The process piping from each of the three zones was then connected to a manifold and combined into one process line that connects to a skid-mounted blower SVE system.

The SVE system was delivered to the site by EnviroSupply on 10 November 2005 and includes a blower, blower motor, cooling fan, water vapor separator, and electrical controls. Off-gas from the SVE system is routed through two sets of two 2,000-pound granular activated carbon (GAC) canisters in parallel in order to remove any VOCs from the extracted vapor stream. The four 2,000-pound GAC vessels were supplied by US Filter and delivered to the site on 8 November 2005. Final mechanical and electrical connections for the SVE system were completed on 2 December 2005.

As-built details of the SVE system are presented in the Operation and Maintenance (O&M) Manual included in Appendix B of this report. The locations of the SVE wells and the system layout are shown on Appendix B, Figure C-3. Piping and instrumentation details are shown on Appendix B, Figure C-4. Typical construction schematics for the SVE wells

and vapor monitoring points are provided on Appendix B, Figures C-5 and C-6.

5.2 OPERATIONAL STRATEGY

The ten SVE wells consist of three Upper Vadose Zone wells (screened from the 15 to 45 feet bgs) and seven Lower Vadose Zone wells (screened from 50 to 90 feet bgs). The SVE system was divided into three individual treatment zones using process piping:

1. Zone A consists of the SVE wells in the Upper Vadose Zone, VEA-01 through VEA-03;
2. Zone B1 consists of SVE wells in the Lower Vadose Zone, VEB-01 through VEB-04; and
3. Zone B2 includes the remaining Lower Vadose Zone SVE wells, VEB-05 through VEB-07.

Each SVE treatment zone will be operated separately until VOC concentrations in the vapor stream have been reduced to lower than 30 percent of the initial concentrations based on either measurements using an organic vapor monitor equipped with a photo-ionization detector (PID) or analytical results from samples collected and submitted to a laboratory. After VOC concentrations have decreased sufficiently, the SVE system will be cycled to the next treatment zone. During initial system operation, ERM anticipates that each treatment zone will be operated for a period of 4 to 8 weeks, followed by an 8 to 16 week recovery period as the SVE system is cycled through the other treatment zones. However, treatment zone operation times may be adjusted based on system performance and engineering judgment.

The SVE system will continue to be operated in the source area until:

- Soil vapor concentrations in the source area have been reduced to below the Maximum contaminant level equilibrium-based soil vapor goals; or
- The SVE system has reached a point of diminishing returns, where the expense of system operation is not justified by the insignificant additional mass of contaminant removed from the ground.

5.3

STARTUP ACTIVITIES

Background/baseline vapor samples were collected from each SVE well on 17 and 18 November 2005. Startup activities began on 7 December 2005, and an initial startup and compliance inspection was performed by the APCD on the same day. The APCD inspector found no violations, and the SVE system was deemed adequate to operate.

Startup activities were conducted using extraction wells located in Zone B1, consisting of Lower Vadose Zone SVE wells VEB-01 through VEB-04, as it is the most contaminated of the three zones (Upper Vadose Zone A1, Lower Vadose Zone B1, and Lower Vadose Zone B2). The system was operated in Zone B1 for approximately 3 weeks in 2005 (December 7 to 31) and continues to operate within this zone in early 2006. The background and startup monitoring information was submitted to the ACPD on 6 January 2006 (ERM, 2006b) and are included in Tables 5-2 and 5-3. Laboratory reports for SVE samples are included in Appendix C. Operation and monitoring of the system will continue as described below in Sections 5.4 and 5.5 and will be summarized in the First Quarter 2006 progress report.

5.4

OPERATION AND MAINTENANCE

The O&M Manual (Appendix B) includes startup and shutdown procedures, as well as maintenance procedures for various components of the system. Routine O&M activities will also include replacing spent GAC when necessary. Carbon usage rates will be calculated using analytical results from the monitoring program. When primary GAC canisters are expected to exhibit breakthrough based on the calculated usage rate, a PID will be utilized to screen the effluent from the primary GAC canisters for breakthrough on the weekly basis. Once breakthrough is confirmed by the PID readings and/or analytical results, the SVE system will be turned off and the spent GAC in the primary canisters will be removed and replaced with fresh GAC. The flexible tubing between the primary and secondary GAC canisters will then be adjusted to route the SVE off-gas through the secondary canisters first (making them primary canisters while the canisters with fresh GAC become secondary canisters). The change-out frequency of the GAC canisters will be determined using system monitoring data and is expected to decrease with time during the operation of each treatment zone.

MONITORING

Monitoring of the SVE system will be conducted as described in Section 4.0 of the O&M Manual (Appendix B). Data collected during O&M activities will be utilized for performance evaluation and optimization activities. For instance, VOC concentrations in the system influent will be evaluated to determine the cycling schedule between treatment zones. Monitoring data will also be used to determine mass removal rates and the observed radius of influence within each zone of operation.

The goal of this remedial action is the delivery of KMnO_4 into the saturated zone to oxidize dissolved-phase VOCs in the Area 1 source area. Appendix C of the RDIP (ERM 2005a) describes the approach used to calculate dissolved VOC mass, chemical and soil oxidant demand for KMnO_4 , volume of KMnO_4 needed to oxidize VOCs in the source area, and the methodology used to deliver the KMnO_4 to the saturated zone.

The ISCO program is being implemented in a phased approach, which includes installation of chemical injection wells upgradient and performance monitoring wells downgradient of the source area, injection of 2 percent KMnO_4 solution into injection wells over a 3-year period, and monitoring of downgradient wells to evaluate the effectiveness of chemical injection and to ensure that Well 70 is protected. The installation of injection and monitoring wells, chemical injection, and injection monitoring completed in 2005 are described in the subsections that follow.

6.1

INJECTION WELL INSTALLATION

As proposed in the RDIP, nine new injection wells were installed on site in the Area 1 source area (HFINJ-02 through HFINJ-10) for the ISCO program. The new injection wells were installed on approximately 50-foot spacing east of Hanger P-3, as shown on Figure 6-1. All new chemical injection wells were installed using a hollow-stem auger drill rig and were constructed of 4-inch diameter, Schedule 40, PVC casing and screened with 0.04-inch perforations. The new chemical injection wells were screened in the B-Zone from 105 to 120 feet bgs. Table 6-1 summarizes construction details for all new ISCO injection wells.

6.2

CHEMICAL INJECTION

As described in the RDIP (ERM 2005a), approximately 44,000 pounds of KMnO_4 will be required to treat dissolved-phase VOCs in the source area. The total mass of KMnO_4 is scheduled to be injected during eight events over a 3-year period; injection events will be completed quarterly during the first year and semiannually during the following 2 years. The first event was completed between 15 November and 1 December 2005. During this initial injection event, each injection well shown on Figure 6-1 received a 2 percent solution consisting of 612 pounds of KMnO_4 mixed

with 3,630 gallons of water. The KMnO_4 solution was mixed in a trailer mounted tank in 330 to 660 gallon batches and was gravity fed into each well. During the event, a total of 32,670 gallons of solution (5,508 pounds of KMnO_4) was injected into the saturated zone beneath the source area. Table 6-2 provides the volume of KMnO_4 solution injected to each well, as well as approximate injection rates.

6.3 *ISCO MONITORING*

As described in Appendix C of the RDIP (ERM, 2005a), the injection monitoring program consists of the following:

- Baseline monitoring to determine ground water conditions prior to beginning chemical injection;
- Performance monitoring to evaluate the effectiveness of KMnO_4 injection, monitor downgradient migration of KMnO_4 solution, and verify the local ground water flow rate; and
- Monitoring of select wells to evaluate potential migration of KMnO_4 to Well 70.

Injection monitoring completed in 2005 included baseline monitoring of select wells in September, prior to implementation of chemical injection, and the first post-injection, monthly monitoring of KMnO_4 and oxidation/reduction potential (ORP) in December.

6.3.1 *Baseline Monitoring*

Baseline monitoring was conducted in September 2005, prior to chemical injection. In accordance with the RDIP (ERM, 2005a), 16 wells were monitored to establish pre-chemical injection ground water conditions. These wells included HFINJ-1, HFPZ-02, MWBP-09B, MWBP-09C, MW5-01B, MW5-01C, MWBP-05B, MWBP-05C, and HFMW-05H, HFMW-35A through HFMW-40A, and HFMW-40C. Samples were analyzed for the following parameters:

- VOCs by USEPA Method 8260B;
- Dissolved metals (chromium, iron, manganese, and potassium) by USEPA Method 6010B;
- Chloride by USEPA Method 300.0A;
- Hexavalent chromium by USEPA Method 7196A;
- Nitrate by USEPA Method 353.2; and

- Total alkalinity by USEPA Method 310.0.

Analytical results for VOCs in baseline-event samples are summarized in Table 2-7. Table 6-3 summarizes inorganic constituents detected in ground water samples collected during the baseline sampling for the ISCO program.

6.3.2 *Performance Monitoring*

In accordance with the RDIP, performance monitoring conducted during 2005 included measurement of KMnO_4 concentration and ORP in injection wells (INJ-02 through INF-10) and monitoring well HFMW-35B. ORP and KMnO_4 concentrations were measured in grab samples using a battery-powered, hand-held instrument and HACH Manganese LR, Pocket Colorimeter. The results of the performance monitoring are summarized in Table 6-4. As indicated, ORP readings ranged from 251 to 673 millivolts. Monitoring well HFMW-35B did not contain detectable levels of KMnO_4 and concentrations of KMnO_4 in injection wells exceeded the upper limit of the instrument's range. Purple coloration due to dissolution of KMnO_4 was visually observed in all injection wells. Methodologies for the field measurements of ORP and KMnO_4 are currently being reviewed and refined. ERM will prepare standard operating procedures for the methods following review and approval by the RWQCB.

Quarterly ground water monitoring will continue throughout 2006. The First Quarter 2006 event is scheduled for March 2006.

The SVE system is currently being operated in Zone B1 and monitored weekly as required in the APCD permit. In addition, biweekly monitoring is being performed as detailed in the O&M Manual (Appendix B). VOC concentrations in the system influent will be evaluated to determine when to cycle the SVE system to the next treatment zone (Zone B2 and then Zone A1).

The second round of ISCO injections was scheduled for the weeks of 13 and 20 February 2006. The performance monitoring associated with the ISCO program was modified due to the detection of KMnO_4 in HFMW-35B within 60 days of injection. The modified monitoring included HFMW-42B then HFMW-36B starting in February 2006, as discussed with the RWQCB.

Future quarterly progress reports will summarize ground water monitoring activities, operation and maintenance activities of the SVE system, and ISCO injection activities and performance monitoring.

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